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That I am knowledgeable in the English language and in the language in which the below identified international application was filed, and that I believe the English translation of the international application No. PCT/AT 00/00204 is a true and complete translation of the above identified international application as originally filed on July 25, 2000.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date

January 8, 2002

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Apparatus for Forming a Strip of Dough

The invention relates to an apparatus for forming a strip of dough, comprising a framework and two sets of superimposed rollers disposed adjacent to each other and driven for rotation around their horizontal axes, the rollers of each set being bearingly supported on a roller carrier movable relative to the framework, wherein the dough passes from above to below through the gap remaining between the two roller sets, which gap narrows to below, all rollers of one set being driven in the same direction, however, the lower rollers of the set being driven faster than the upper rollers of the same set, and wherein the roller carriers of the two sets can be moved one against the other or apart from each other by eccentric drive means.

As it is known, difficulties occur when a mixed charge of dough, the volume of which can be of different size, however, in the most cases being equal to the capacity of the kneader, which volume in the most cases is supplied by a hopper, must be formed in the shape of a continuous strip of dough, which has a predetermined width and an also predetermined thickness that is at least substantially constant. These difficulties result from that mixed dough is sensitive with respect to its structure that means its physical and chemical properties, to the stresses occurring when it is formed to a continuous strip. In particular, this holds for doughs subjected to a long fermentation time that is desired with respect to increase the quality of the product without additional effort (additions).

An apparatus of the initially described kind has become known (EP 744 126 A1), in which each set of rollers is bearingly supported for rotation on a pivoted lever constituting the roller carrier. The upper end of this pivoted lever is stationarily linked to the framework and can be pivoted around this linkage point by an eccentric drive means. The pivotal movements of the two roller carriers work always in opposite direction so that the gap through which the formed strip of dough discharges from the apparatus to below, is

alternately increased or decreased. Thereby, indeed a continuous strip of dough of substantially constant thickness can be obtained, but this known apparatus is not completely free of undesired dough stresses so that the dough structure is adversely affected, in particular for sensitive kinds of dough or for doughs subjected to a long fermentation time.

The invention has at its object to improve an apparatus of the initially described kind so that the dough is brought into its desired strip shape very carefully. The invention solves this task in that an eccentric is bearingly supported on each roller carrier and is driven for rotation opposite to the direction of movement of the dough, and that each roller carrier is bearingly supported on a further eccentric or a connecting rod at a point that is located higher or lower than this eccentric, wherein this further eccentric or this connecting rod is bearingly supported for rotation or pivotal movement on the framework. As distinguished from the pivotal movement of the two roller carriers occurring in the above described known construction, within the inventive apparatus there occurs a movement of each roller carriers that comprises not only a horizontal component but also a significant vertical component, this horizontal or vertical component occurs not only at the lowermost rollers of the roller carrier but also at the uppermost rollers. So to speak, there occurs a wave motion of the two roller carriers so that the dough disposed between the two roller sets is not only subjected to a thrust action performed by the rotational motion of the rollers, but also to a pumping effect, the size and kind of which depends from the size of the eccentricity of the eccentrics used or from the length of the connecting rods used and from how and where they are pivotally connected to the respective roller carrier. Simplifying, it can be said that the dough is stepwisely and gently rolled into the desired shape.

As distinguished from the above described known construction, according to the invention the eccentrics act directly on the respective roller carrier, whereas within the known construction, the pivotable roller carrier is always connected via a connecting rod to an eccentric pin of the drive means.

According to a further embodiment of the invention, the rollers of the two roller sets have diameters that are equal to each other, what results in low costs of manufacture and makes it easier to adjust as desired the different speeds of revolution and the thereby created thrust and pumping actions acting on the dough.

According to a particular favourable embodiment of the invention, each roller carrier is formed by two walls, laterally confining the gap. The ends of the rollers can be bearingly supported in these walls, for example by means of bearing necks, and the drive members for the rotational motion of the rollers can also be supported by the roller carriers. Within such a construction, the walls constituting the roller carriers may form the lateral delimitation for the dough that flows through the gap between the roller sets, and, therefore, can act as lateral shields for the width of the dough strip to be produced, if this was not already made earlier, for example by a corresponding exit cross section of a supply hopper or the like.

According to a further embodiment of the invention, the eccentric or the eccentrics or the connecting rod can be adjustable. This adjustment may comprise a change of the eccentricity of the eccentric and/or a change of its bearing location and/or a change of the length and/or of the linkage points of the connecting rod. In such a manner, the motion of the roller carrier and thus its roller action onto the dough can be varied, so that one can accommodate to different qualities of the dough, what is of importance in particular for processing dough of different viscosity.

It is particular suitable to dispose above the gap delimited by the driven roller sets, adjacent to the respective upper rollers, two further sets of freely rotatable superimposed rollers side by side, wherein preferably the gap delimited by these two roller sets is at least as width as the mean width of the gap delimited by the driven roller sets. The space disposed between these further roller sets constitutes a compensating space for a dough mass that is disposed between the driven roller sets carried by the roller carriers and is pressed to above, when these roller sets are moved and thereby projects beyond the

uppermost rollers of the two driven roller sets. This upwardly pressed amount of dough is taken up by the said compensating space and is again delivered to below as soon as the driven roller sets move away from each other. Within this, it is suitable to dispose the rollers of each one of the further roller sets superimposed in vertical direction and to make them of always the same size, however, to keep the diameter of the rollers of these further roller sets less than that of the driven rollers.

As it is well known, it is frequently desired to introduce one or more flowable substances onto or into the dough. Such substances may be for example baking oil, separating oil, olive oil, however, also egg white, honey, sugar solution or oxygen or fermentation gases to influence the properties of the dough, further moistening agents, in particular water as a preparation for a subsequent sprinkling or dusting step, for example with poppy seed, sesame or the like, or sodalye for the production of salted baked products, gloss substance for the production of brioche, substances (in particular oils) to improve the taste and the like. The invention enables one to impinge the dough with the flowable material, when the dough passes the gap disposed between the driven roller sets. For this, according to the invention, at least one roller is provided with at least one conduit for supplying a flowable medium to the dough, which conduit extends in longitudinal direction of the roller, the roller jacket surrounding this conduit being constituted by a sintered body that is permeable for this medium. The medium that is to be supplied onto the dough can flow or diffuse through this sintered body, and, if desired, the applied medium may be worked into the dough by the stresses exerted onto the dough by the roller sets. Within that, it is of advantage that thereby the medium can be substantially more regular applied onto the dough, as this was possible by the usual dropping or spraying of the medium. Further, losses are substantially reduced because the medium can be applied onto the dough by the rollers in a completely exact manner, so that nothing or nearly nothing that leaves the rollers, misses the dough. Thereby, the amount of the medium that is applied onto the dough can be

exactly dosed and soiling of neighbouring machine elements can be avoided. Further, this applying is more flexible with respect to different kinds of the medium to be applied, and is more exact with respect to the location where it is applied.

It is recommendable for rollers constructed in the above sense to use sintered bodies of a material that is compatible with foods and is dough repelling, preferably polyamide. The average molecular weight for this has to be suitably chosen, for example about 800 to 1200, preferably about 1000, whereby the sinter volume amounts to 60 to 90 % (corresponding to a hollow space content of 40 to 10 %). In particular suitable within the spirit of the invention are sintered bodies of sintered granules of synthetic plastic material having an average grain size of 0.2 to 1.0 mm.

Further features and advantages of the invention can be seen from the description of embodiments schematically shown in the drawings. Fig. 1 shows an embodiment in a vertical section. Fig. 2 shows the driven roller sets, bearingly supported in roller carriers, of the embodiment according to Fig. 1, in an enlarged scale. Fig. 3 is a section taken along the line III - III of Fig. 2. Fig. 4 shows a variant to Fig. 2 and Fig. 5 is a section taken along the line V - V of Fig. 4. Figs. 6 to 9 show in sections similar to Figs. 2 and 4 further embodiments. Figs. 10 and 11 show two variants for the adjustment of the gap existing between the two roller sets. Fig. 12 shows in a vertical section the supply of a flowable medium to the rollers and Fig. 13 is a section taken along the line XIII - XIII of Fig. 12.

Within the embodiment according to Figs. 1 to 3, the dough to be processed which may have been subjected to a long fermentation time, for example a kettle fermentation, is filled into a filling hopper 1 from above, the capacity of which corresponds suitably to the nominal capacity of the kneader by which the dough was previously processed. The hopper 1 is put onto the machine framework 2 and has below an outflow opening 3, the width of which, measured perpendicularly to the drawing plan, already determines the width of the dough strip or dough band to be produced. From the outflow opening 3 the dough 4 gets

between two endless bands 5, 6 guided over rollers 7, 8, the rollers 7 of which are so driven that the two bands 5, 6 circulate stepwisely or continuously in direction of the arrows 9. The two bands 5, 6 have a longitudinal extension that is so obliquely disposed that the smaller rollers 8 are disposed below and neighbouring the vertical axis 10 of the hopper 1. Guide members, which are not shown, may guide the bands 5, 6 so that the two lower most rollers 8 change their position periodically so that the gap 11 between the two rollers 8 changes its width and/or its position relative to the axis 10 periodically. From the gap 11, the dough 4 comes between two cylinders 12 or rollers which rotate in opposite direction in the sense of the arrows 13 and may, but must not, be driven in this direction. The gap 14 between the two cylinders 12 determines in the first instance the thickness of the strand or band of dough and may have an adjustable size, if desired. The so produced dough band reaches a conveyor belt 15 which conveys the dough 4 to a further hopper 16 fixed in the framework 2 of the apparatus. Thereby, the dough band guided to the hopper 16 looses its substantial uniform thickness again, which, however, will be restored in a manner which will be described later on. The outflow opening 17 of the hopper 16 can, but must not, have a width corresponding to that of the outflow opening 3, and can define the width of the dough band to be produced. From the hopper 16, the dough gets between two roller sets 18, 19, each of which comprising four rollers 20 superimposed above each other in vertical direction and respectively of equal size. These rollers are freely rotatable, their peripheries are closely neighbouring each other or are in contact with each other. The rollers 20 are stationarily bearingly supported within the framework 2, suitably in sidewalls adjacent the outflow opening 17.

Adjacent to the roller sets 18, 19 further roller sets 21, 22 are disposed, each of which in the embodiment shown comprises four superimposed rollers 23. The rollers 23 of each one of the roller sets 21, 22 have ends in the form of shaft stubs 69 and are bearingly supported therewith on roller carriers 24 by means of rolling bearings 25 (Fig. 3), the roller

carriers 24, when measured perpendicularly to the axial direction of the rollers 23, have a substantial greater width than the diameter of the rollers 23, which diameter suitably is the same for all rollers 23. In such a manner, each roller carrier 24 consists of two walls 54 bearingly supporting the rollers, which walls constitute the sidewalls for limiting the side of the dough, mostly only a narrow gap 26 (Fig. 2) remaining between each two roller carriers 24, which gap enables the relative motion of the two roller carriers 24 in direction towards each other or away from each other. The bearing locations of the rollers 23 in the roller carriers 24 are so chosen that the distance between each two opposing rollers 23 narrows towards below, therefore in flow direction of the dough, and this is in all positions of the roller carriers 24, so that, therefore, the gap 50 relevant for the flow of the dough between the roller sets 18, 29 narrows towards below. From the roller group formed by the two roller sets 21, 22, the dough 4 flows out in form of a continuous dough band of constant width and substantially constant thickness and gets onto a conveyor belt 27 guided over a roller 29 driven by a motor (not shown) so that it circulates in direction of the arrow 28. At the deliver position 30, this conveyor belt 27 may deliver the dough band to a further processing step, for example forming, portioning and the like, or these further processing steps of the dough 4 can be made partially or completely already on the section of the conveyor belt 27 being positioned laterally with respect to the roller group 31.

The rollers 23 of each roller set 21, 22 are driven in the same direction, the direction of circulation is indicated by arrows 32 (Fig. 1, 2). These directions of circulation are oppositely directed for the two roller sets 21, 22, so that the dough between the two roller sets 21, 22 is conveyed downwardly by the rollers 23. Each roller set 21, 22 is driven by a motor 33 each (Fig. 3), which drives chain wheels 35 via a chain 34, which chain wheels are connected for common rotation with the shaft stubs 69 of the rollers 23. Since the two roller carriers 24 move relative to each other, suitably an own drive means is provided for the rollers of each one of the roller carriers 24 (Fig. 6 to 9). However, by suitably choosing the

transmission ratio between chain 34 and chain wheels 35, the construction is such that the lower rollers 23 rotate with a higher rotational speed than the upper rollers 23.

A further motion is superimposed to the described circulating movement of the rollers 13, which further movement is transferred to the rollers 23 via the roller carriers 24. For this, each roller carrier 24 is driven by means of an eccentric means 36. Each eccentric means 36 has an eccentric disk 37 bearingly supported within the framework 2 by means of bearings 38 and carrying an eccentric pin 39 lenghtened to a rod extending in axial direction of the rollers 23, which rod connects the two roller carriers 24 disposed on both sides of the rollers 23. This rod-shaped eccentric pin 39 is bearingly supported within the roller carriers 24 by means of bearings 40. This construction is shown in Figs. 2 and 3. However, the arrangement can also be an inverted one, i.e. that the eccentric disks 37 are bearingly supported within the roller carriers 24 and the eccentric pins 39 within the framework 2. Within the embodiment shown, the one eccentric disk 37 carries a concentric chain wheel 41 driven by a motor 43 via a chain 42. The chain 42 runs over a further chain wheel 44 that drives a further eccentric means 45, the eccentric disk 46 and the eccentric pin 47 of which are bearingly supported within the framework 2 or within the roller carrier 24, respectively, in an analogous manner as this has been described for the eccentric means 36.

This supporting by eccentric means 36, 45 is the same for the roller carriers 24 of both roller sets 18, 19, however, symmetrical with respect to the axis 48 of the gap 26.

The direction of revolution of the motor 43 or, respectively, the direction of the run of the chain 42 are so chosen that the eccentric pins 39 or 47 revolve in a circular movement in direction of the arrows 49, and therefore, opposite to the direction of movement of the dough in the gap 50 between the two roller sets 21, 22. Within this, the two eccentric pins 39, 47 are angularly offset with respect to each other. As Fig. 2 shows, the lower eccentric pin 39 has already reached almost its highest position, whereas the upper eccentric pin 47 has only started its upward movement. Thus, when the eccentric means 36, 45 rotate, there results

for the two roller sets 21, 22 a movement that is superimposed to their revolving motion, which superimposed movement comprises a horizontal component as well as a vertical component. Therefore, there results a motion of the two roller sets 21, 22 that is directed towards each other or, respectively, opposite to each other and is directed upwardly or, respectively, downwardly, wherein, however, the lower rollers 20 of the two roller sets 21, 22 mostly approach or, respectively, remove from each other at another time than the upper rollers 20 of these roller sets. The so produced wobbling motion of the two roller sets 21, 22 results in a pressure or kneading action on the dough, however, the dough is treated gently, so that the dough is gently brought into the desired dough band shape. Within this, there results a certain breaking effect onto the dough flowing between the rollers 20, caused by the correspondingly selected revolving direction of the eccentric means 36, 45. However, the conveyance action of the rotational motion of the rollers 20 around their axes is directed opposite to this breaking effect, whereby the lower rollers 20 of each roller set 21, 22 rotate with a higher speed than the upper rollers of the same roller set. This different rotational speed of the single rollers 20 can easily be achieved by selecting the size or teeth number of the chain wheels 35 co-operating with the chain 34. By the co-operation of all of these movements, the dough is not only pumped or pressed through the gap 50 existing between the roller sets 21, 22 and tapering downwardly, but is also stepwisely and gently rolled into the desired shape.

The embodiment according to Figs. 4 and 5 differs from that according to Figs. 1 to 3 in that instead of the upper eccentric means 45 connecting rods 51 are provided. Each connecting rod 51 is pivotally connected at its one end by means of a swivel bearing to the framework 2, and at its other end to the corresponding roller carrier 24, also swivellably. Suitably, the latter pivot location 53 is so chosen, that it coincides with the axis of the uppermost roller 20. Within this embodiment, the connecting rods 51 are directed

downwardly from the swivel bearings 52 and towards the gap 50. Within this, the operation is substantially the same as within the embodiment according to Figs. 1 to 3.

In the Figs. 6 to 9 different embodiments for those members are shown by which the said wobbling motion of the two roller carriers 24 is created. Within this, the embodiment according to Fig. 6 is, in general, equal to that according to Fig. 4, i.e., the eccentric drive means is disposed below and the connecting rods are disposed above, wherein the connecting rods 51 are directed inwardly and downwardly from their pivot locations 52 at the framework 2.

Therefrom, the embodiment according to Fig. 7 differs in that the connecting rods 51 are directed upwardly from their pivot locations 52 at the framework 2.

Within the embodiment according to Fig. 8, the eccentric bearing is located above and the connecting rod pivot below. The connecting rods are directed from their pivot locations at the framework downwardly and inwardly. The pivot location 53, therefore, is no more located near the uppermost roller 20 of the respective roller set 21 or 22, but near the lowermost roller 20.

Therefrom the embodiment according to Fig. 9 differs in that the connecting rods 51 are directed upwardly from their swivel bearings 52 at the framework 2.

The Figs. 6 to 9 show further schematically the already described drive means for the revolving motion of the rollers 20 and for driving the respectively used eccentric means 36 or 45.

In addition thereto, in the Figs. 1, 2 and 6 to 9 means are shown by which the average width of the gap 50 can be varied that remains between the two roller sets 18, 19 and is relevant for the through-flow of the dough. These means comprise adjustment means acting onto the two roller carriers 24. For this, within the described embodiments each roller carrier 24 in its lower section is provided with a toothed rack 55 meshing with a toothed wheel 56 that is bearingly supported on the framework 2. Thereby, an adjustment of the two

roller carriers 24 in direction of the double arrows 57 is possible. The adjusted position can be secured by fixing means, not shown.

Fig. 10 shows the described adjustment possibility in the extreme position in which the two lower sections of the two roller carriers 24 are brought into maximum approach to each other, so that the gap 50 between the two roller sets 18, 19 has reached its narrowest adjustment below. As Fig. 10 shows, the adjustment possibility for the width of the gap 50 described until now has its effect chiefly onto its lower section. If it is desired to adjust also the upper section of the gap 50, a similar adjustment possibility can be provided also for the upper sections of the two roller carriers 24, as this is shown in Fig. 11. Within this, the adjustment region can be so wide that the edges of the walls 24 constituting the roller carriers 24 contact each other in pairs, as this is shown in Fig. 11.

An analogous adjustment possibility, of course, can be applied also for the swivel bearings 52 of the connecting rods 51.

It is suitable to dispose the described adjustment means, in particular the toothed racks 55 and the toothed wheels 56, in the region of the eccentric means 36 or 45 or in the region of the swivel locations 52 of the connecting rods 51. If desired or necessary, however, the described adjustment means for the width of the gap 50 can act also on other locations of the roller carriers 24.

Within the embodiment according to Figs. 12 and 13, a flowable medium can be conducted into several or all of the rollers 20 of the roller sets 18, 19, which medium reaches the dough through the rollers 20. For this, each roller 20 has at least one conduit 59 extending in the longitudinal direction of the roller, suitably in the region of the roller axis 58, into which conduit the flowable medium, for example baking oil, egg white, aroma compound solutions, but also oxygen or fermentation gases for influencing the dough properties, is introduced in direction of the arrow 60 from a line 61 via a rotating coupling 62. Suitably, the conduit 59 is formed by a hollow shaft 63 of steel, the end of which remote from the rotating

coupling 62 is closed. The wall of the hollow shaft 63 comprises a plurality of radially extending openings 64 through which the flowable medium can flow to the jacket 65 of the roller 20. Suitably, this jacket 65 on its inner side is provided with an annular distribution space 66 into which the medium flows in direction of the arrows 67 and from which it enters the jacket 65. In order to enable the flow through the jacket 65, it consists of a sinter body permeable for the medium, suitably of dough-rejecting material, for example polyamide having an average molecular weight of about 1000, whereby the sinter volume amounts to 60 to 90% (corresponding to a hollow space content of 10 to 40%). Such a porous sinter body may consist of grains of synthetic plastic material having an average grain size of 0.1 to 1.0 mm, for example 0.2 to 0.35 mm. The medium passed into such a sinter body penetrates this sinter body or diffuses it and, therefore, reaches the peripheral surface 68 of the jacket 65 and therewith the dough 4 being in contact with this peripheral surface.

Such an apply of the medium onto the dough 4 is advantageous as well with respect to the local apply as with respect to the uniformity of the apply and with respect to avoiding soiling of neighbouring machine elements.

As Fig. 12 shows, a plurality of rollers 20 can be connected in common to the line 61, into which the medium to be applied onto the dough 4 is introduced under pressure by a pump, not shown. An alternative embodiment consists in to connect individual rollers 20 to different lines 61, so that different media can be applied in different doses.

As Fig. 1 and 12 show, above the roller group 31 formed by the roller sets 21, 22 there is provided the device formed by the roller sets 18, 19. This device has the purpose to take up dough quantities, if any, rising upwardly from the roller group 31 during the pumping motion of the roller sets 21, 22, and to conduct these dough quantities back again into the roller group 31. For this, the rollers 20 of the roller sets 18, 19 are freely rotatable, suitably the peripheral surfaces of these rollers 20 contact each other so that a sidewise escape of the dough is avoided. A similar contact of the peripheral surfaces 68 of the rollers 20 is also

present within the embodiment according to Fig. 12, however, this is not compulsory, as Fig. 1 shows, wherein the peripheral surfaces of the several rollers 23 are spaced apart from each other for a small distance.

As Fig. 1 shows, the rollers 20 of the roller sets 18, 19 are disposed adjacent to the uppermost rollers 23 of the roller group 31. The gap confined by the roller sets 18, 19 is at least as wide as the mean width of the gap 50 of the roller group 31. The rollers 20 superimposed in vertical direction have the same size, however, their diameters are always smaller than the diameters of the rollers 23 of the roller group 31.